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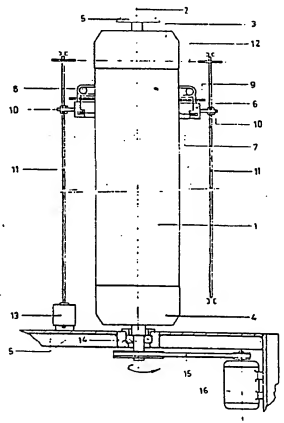
(54) Title: METHOD AND APPARATUS FOR MANUFACTURING CONTINUOUS DESIGN ROLLERS

(57) Abstract

Method for manufacturing seamless design rollers, which method is carried out on the outer surface of a vertically positioned cylindrical core (1),-which core comprises an outside covering of elastomeric material and, if desired, an adhesion promoting layer-; the method comprises the uniform coating of said surface with a layer of liquid photopolymer said layer being simultaneously evenly exposed by a source (8) of UV-radiation, so effecting a partial curing of the freshly deposited layer, which prevents a sagging of the photopolymer, during which coating process the cylindrical core and the UV-exposure source (8) perform a relative rotation. Subsequently a second step of UV-curing is carried out by means of a patternwise exposure of the respective layer, with a mask being the negative of the desired pattern, whereupon the exposed layer is developed and dried, so that a relief image of the desired shape is left.



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METHOD AND APPARATUS FOR MANUFACTURING CONTINUOUS DESIGN ROLLERS.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention concerns a method for manufacturing continuous design rollers, consisting of a cylindrical core with an outside covering of elastomeric material in which method the cylindrical core, which may have an adhesion promotion layer on its surface, is coated with a layer of liquid photopolymer material, which material is cured by UV-radiation in such a way, that after development and drying a relief image of the desired shape is left.

In the field of this invention liquid photopolymer material is used which has the property of being cross-linkable by exposure to UV-radiation, whereupon the liquid state transforms into the solid state.

Elasticity and hardness of the end product are related to the chemical composition and can vary from rubber-like to relatively hard.

The very elastic products find their use in the flexography, whereas hard products are applied in book-printing.

In said field use is made of the property that the solubility of such photopolymers in certain solvents is reduced as a result of UV-exposure. Substances which, for example, in non-exposed condition are water developable,

loose this property when the polymerization has proceeded so far, that the product is transformed from the liquid into the more or less solid state.

The product is then still soluble in certain solvents so as chlorinated hydrocarbons or other organic solvents.

2. Description of de Prior Art.

So far, liquid photopolymer substances were coated in the desired thickness onto horizontally rotating cylindrical cores.

During said coating the thickness of the layer is controlled by means of a glass plate, on the surface of which a film is applied containing the negative pattern in UV-impermeable parts. The film is covered with a very thin, UV-radiation transmitting foil, on which the photopolymer substance does not adhere.

Imagewise exposure of the photopolymer through the film is carried out during the coating process.

Obviously this process requires very much accuracy of the respective apparatus.

Furthermore, the control of the layer thickness is very critical.

A known method for application of a liquid coating to a cylinder is described in British Patent 1 455 289, in which method the thickness of the liquid layer is very easily controlled.

Said Application discloses a method in which a vertical cylindrical member is coated with liquid material by the use of an annular reservoir, being positioned around the cylinder and fitting to the outer surface of the cylinder in such a way that a thin liquid coating is

left on the surface, when the reservoir is moved in a controlled way along the cylinder from top to bottom.

By control of the vertical movement the layer thickness on the cylinder surface is governed.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a method which is less critical with regard to accuracy in the coating stage, whereas the coating thickness is very easily controlled.

According to the invention this is attained in that the cured photopolymeric covering in pattern form is applied to the outside of a cylindrical core in such a way that UV-curing of the liquid photopolymeric material is carried out in at least two steps, comprising a first step in which a homogeneous exposure with UV-radiation is carried out during the process of applying a homogeneous coating of liquid photopolymer in a known manner to the outer surface of a vertically positioned cylindrical core, the exposure being such that a partial curing, preventing flow of the photopolymer is achieved, and a second step in which a pattern-wise exposure to UV-radiation is carried out, using a film, which is the negative of the desired pattern, as a mask, after which the exposed layer is developed and dried in a known way.

The first step of the UV-curing process is a homogeneous exposure to UV-light, due to which a viscosity increase of the photopolymer is realized which is such, that flow of the layer after application is prevented.

The second step of the UV-curing process can be carried out either in a separate exposure machine or in the coating apparatus itself. In both cases a film having a pattern which is the negative of the desired pattern is

wrapped around the coated cylinder after which exposure is carried out in a known way.

Preferably there is provided a relative rotary movement between the cylindrical core and the UV-source during the first exposure step, so as to ensure a perfectly homogeneous exposure of the total cylinder surface.

It has appeared to be very beneficial to apply a homogeneous post exposure with UV-radiation to the developed and dried printing cylinder in order to ensure a total curing of the exposed portions.

The present invention is not restricted to the use of thick-walled printing cylinder cores as are usual in printing industries.

Thin-walled, seamless cylinders can also be used, consisting for instance of nickel, which cylinders can be mounted in a known way on cylindrical rigid cores, by means of pneumatical processes.

The present invention is also embodied in an apparatus for carrying out the aforedescribed method. This apparatus comprises means for mounting a cylindrical core with its central axis in a vertical position, an annular reservoir being positioned around the cylinder, fitting in a sealing way to the cylinder surface which reservoir can be moved along the cylinder in a controlled way.

This known apparatus comprises for the purpose of the present invention an annular UV-radiation source which exposes an area directly above the reservoir while the vertical movement of the source is identical to that of the reservoir, a UV-shield between reservoir and source and means providing a relative rotary movement of the

source with respect to the cylinder.

It has appeared to be benificial to give a rotation to the cylinder to be coated, whilst the source is being kept stationary.

DESCRIPTION OF THE DRAWING

The drawing is a vertical cross-section of the present apparatus.

DESCRIPTION OF A PREFERRED EMBODIMENT

The apparatus consists of a cylindrical core 1 with a vertical upright axis 2.

Mounting means 3 and 4 of the core 1 are rotatably installed in bearings in frame part 5.

Around cylinder 1 an annular reservoir is situated, said reservoir consisting of a wall 6 and a sealing ring 7, co-operating with the outer surface of core 1.

Above reservoir 6, 7, an annular UV-source 8 is mounted in fixed relationship to the reservoir and close to the reservoir.

Between source 8 and reservoir 6, 7 a UV-impermeable shield 9 is situated.

The reservoir 6, 7 with source 8 and shield 9 are supported on bearings 10 on single spindles 11. The spindles are interconnected in the top by means of an endless chain 12 or the like, to give the same rotational direction while one of the two spindles 11 is connected to a drive motor 13.

The lower end 4 of the core 1 is, via mounting means, 14, connected with a gear box 15 and the drive motor 16.

By energising motor 13, the reservoir 6, 7 can be

driven together with shield 9 with uniform speed along the outer surface of core 1. Motor 16 is suited to rotate core 1 slowly during the vertical movement of the reservoir.

The method according to the present invention is carried out as follows:

By means of motor 13 reservoir 6, 7 is placed in the upper position whereupon said reservoir is filled with liquid photopolymer.

Motor 13 is then started for the downward movement of reservoir 6, 7 while source 8 is put on.

It is beneficial to also energise motor 16 so as to rotate core 1 slowly around its vertical axis, although this is not essential for the envisaged method.

During the downward movement of reservoir 6, 7 a coating layer of photopolymer adheres to the outer surface of core 1.

UV-radiation of source 8 can only radiate that part of coating, which is situated above shield 9, by which exposure the substance is thus partially hardened so that no streaming will occur.

When the reservoir has reached the bottom end 4 motors 13 and 16 are stopped, after which core 1 is removed from the machine, for instance by removing the upper part of frame 5.

Subsequently, the negative film is wrapped tightly around the coating, whereupon the second exposure is carried out.

Those parts of the coating which correspond to the pattern to be printed will be further hardened by this treatment.

After this second exposure the only pre-exposed parts of the coating will be removed by washing with a

suitable solvent.

If necessary a uniform post-exposure step can be carried out to harden remaining quantities of not exposed photopolymer or insufficiently hardened photopolymer.

As an example of photopolymerisable substances every type of UV-curing mixture whether or not mixed with additives may be chosen, e.g.

1) unsaturated epoxy resins;
2) unsaturated polyester resins;
3) unsaturated alkyd resins;
4) unsaturated acryl resins;
5) unsaturated urethan resins;
6) polybutadiene resins.

Mixtures of unsaturated polymers and UV-curing mixtures of unsaturated polymers with monomeric compounds can also be used.

Furthermore, if necessary, photoinitiators or mixtures of different photoinitiators can be added in quantities of 0,05-10% by weight with respect to the weight of resin.

What is claimed is:

1. Method for manufacturing continuous design rollers consisting of a cylindrical core with an outside covering of elastomeric material in which method the cylindrical core, which may have an adhesion promotion layer on its surface, is coated with a layer of liquid photopolymer material which material is cured by UV-radiation in such a way, that after development and drying a relief image of the desired shape is left, characterized in that, UV-curing of the liquid photopolymeric material is carried out in at least two steps comprising a first step in which a homogeneous exposure with UV-radiation is carried out during the process of applying a homogeneous coating of liquid photopolymer to the outer surface of a vertically positioned cylindrical core (1), the exposure being such that a partial curing preventing a flow of the photopolymer is achieved, and a second step in which a patternwise exposure to UV-radiation is carried out using a film, which is the negative of the desired pattern, as a mask, after which the exposed layer is developed and dried.

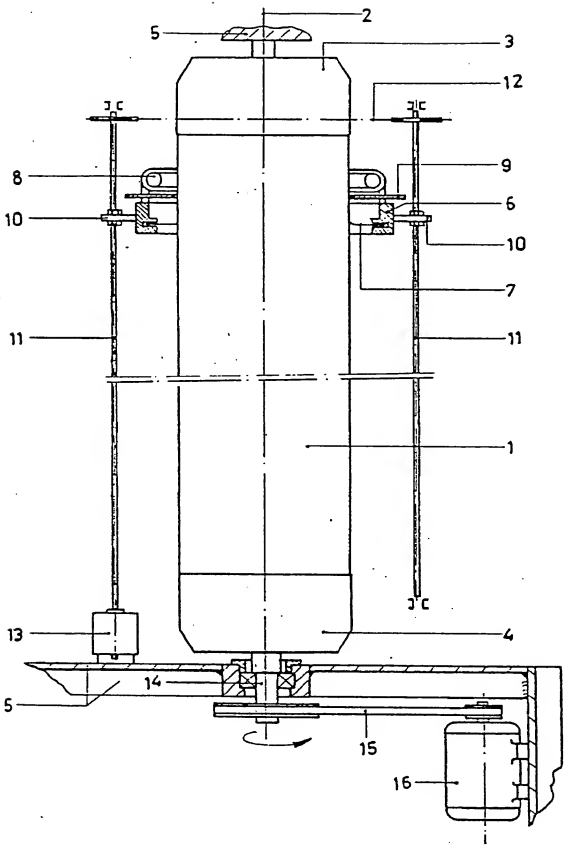
2. Method according to claim 1, characterized in that, during the coating process the cylindrical core (1) and the UV-exposure source (8) are rotated relatively with respect to each other.

3. Method according to claims 1 and 2, characterized in that, after developing and drying, the photopolymer layer is subjected to a homogeneous post-exposure with UV-radiation.

4. Method according to claims 1-3, characterized in that, the photopolymeric covering is applied to a cylindric core (1) made of thin-walled seamless material.

5. Method according to claim 4, characterized in that, the photopolymer coating is applied to a thin nickel sleeve (1).

6. Apparatus for carrying out the method as described in any one or more of the foregoing claims comprising mounting means for a cylindrical core, its central axis being in a vertical position and an annular reservoir being positioned around the cylinder and fitting in a sealing way to the cylinder surface, which reservoir can be moved along the cylinder in a controlled way, the apparatus being characterized in that, it comprises an annular UV-radiation source (8) which exposes an area directly above the reservoir (6, 7), while the vertical movement of the source is identical to that of the reservoir, a UV-impermeable shield (9) being present between reservoir and source, and means (13, 16) to provide for a relative rotary movement of the source (8) with respect to the cylinder (1).



INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 80/00126

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.[3]: G 03 F 7/18; G 03 F 7/24

II. FIELDS SEARCHED

Classification System [4]	Minimum Documentation Searched [4] Classification Symbols
Int.Cl.[3]	G 03 F 7/18; G 03 F 7/24

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
	US, A, 4125644, published November 14, 1978 see the figures 1 and 2, A.D. Ketley et al. ---	1,6
	NL, A, 7217165, published June 18, 1974, see the figure and the claims, Stork Amsterdam corresponding to GB, A, 1455289 ---	4,5,6
	NL, A, 7403490, published October 14, 1974, see the claims, page 1, line 12 - page 3, line 18, page 6, lines 22-34, W.R. Grace corresponding to US, A, 3589091 ---	1
	NL, A, 6914613, published April 28, 1970, see the claims, W.R. Grace corresponding to US, A, 3597080 US, A, 3619601 ---	3
	US, A, 1911124, published May 23, 1933, see figure 1, page 2, lines 46-54, page 3, lines 31-39, Olinder et al. ---	2
		./.

* Special categories of cited documents: [15]

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"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
January 27, 1981	February 5, 1981

International Searching Authority [1]	Signature of Authorized Officer [20]
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No [18]
A	DE, C, 687034, published December 21, 1939, see the figure, the claims, E. Felchow	1
A	NL, A, 7608241, published July 23, 1976, see figure 1, the claims, Stock Brabant corresponding to US, A, 4130084	1,5
A	NL, A, 273451, published September 10, 1964, see the claims, E.I. du Pont corresponding to GB, A, 931368	1
A	Japanese Patents Gazette, Part I, Chemical Section Week X41, issued November 17, 1976 (London, GB), "Curing photohardenable resins in two stages using precure at lower light intensity, gives wrinkle-free prods, see page 5, column 2, the abstract NIOC G02, JP, A, 51096834	1
A	US, A, 2141852, published December 27, 1938, see page 1, right-hand column, lines 5-6, figure 1, C.G. Bingham et al.	2
A	US, A, 3506440, published April 14, 1970, see the claims, E. Sugimoto	3
A	US, A, 1551931, published September 1st, 1925, see the claims, F.M. Carroll	1
A	US, A, 1949234, published February 27, 1934, see the figure, H. Baxter	1